AN ANALYSIS OF THE
PROPOSED CADAM PCB PACKAGE
BASED ON ASI'S PRANCE SOFTWARE

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Mr. Richard A. Bennett
CADAM Program Manager
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  COMPANY
P.O. Box 551
Burbank, CA 91520

~~October~~ November 3, 1780

Dear Mr. Bennett:

Enclosed are ~~six (6)~~ ten (10) copies of the completed report:
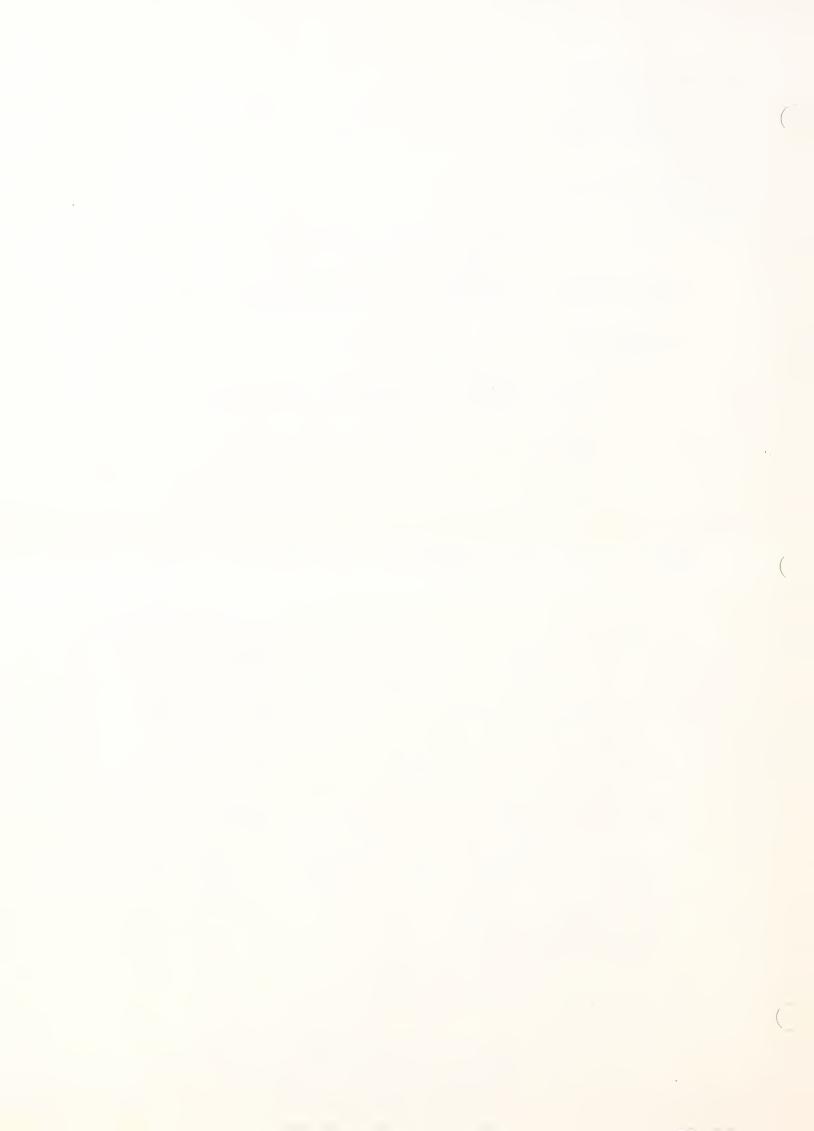
"AN ANALYSIS OF THE PROPOSED CADAM PCB PACKAGE BASED ON ASI'S PRANCE SOFTWARE",

this completes Phase 1 of the custom study.

~~It is~~ INPUT has enjoyed working on this ~~study~~ project with Lockheed, and we look forward soon to presenting the research results of Phase 2, Determining the Market For The Lockheed ~~Distribute~~ Distributed Graphics System. ~~soon~~.

Sincerely,

Kenneth Parker
Senior Consultant

AN ANALYSIS OF THE
PROPOSED CADAM PCB PACKAGE
BASED ON ASI'S PRANCE SOFTWARE

ABSTRACT

This report analyzes the proposed printed circuit module of the CADAM software. The study focuses on evaluating the suitability of Automated Systems, Inc.'s software package, an analysis of competitive packages, recommendations for pricing, and projecting the market.

AN ANALYSIS OF THE
PROPOSED CADAM PCB PACKAGE
BASED ON ASI'S PRANCE SOFTWARE

Prepared For:

LOCKHEED CALIFORNIA COMPANY

OCTOBER 1980

AN ANALYSIS OF THE
PROPOSED CADAM PCB PACKAGE
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AN ANALYSIS OF THE
PROPOSED CADAM PCB PACKAGE
BASED ON ASI'S PRANCE SOFTWARE

LIST OF EXHIBITS

I INTRODUCTION

I   INTRODUCTION

- The primary objectives of this study are to determine the suitability of the Automated Systems, Inc. (ASI) PRANCE printed circuit board (PCB), computer-automated design software package for Lockheed's CADAM, and to establish a price structure for sale or lease of the PCB package.

- A comparison is made of prices and functions of other PCB packages comparable to the proposed CADAM/PCB package.

- Results of the study are presented in order to establish a CADAM/PCB package pricing and business strategy that will result in the greatest market results for Lockheed over the next three years.

A.   SCOPE

- The research conducted in this report identified comparable PCB packages offered in the marketplace in order to:

    - Compare price and function to the proposed CADAM/PCB package.

    - Establish an upper price limit that users would accept.

- Examine the degree of user price sensitivity for the product.

- Recommend price structures for rights to use the PCB software package, either by original outright purchase or by fully paid-up lease.

- Forecast the market for the CADAM/PCB package over the three years following the introduction of the PCB product.

- Recommend an upper price limit that ASI should charge Lockheed for the sale of PRANCE software.

B.   METHODOLOGY

- Vendors offering PCB software packages comparable to ASI/PRANCE were identified by means of an extensive literature search and informal telephone contacts.

    - Nine vendors meeting this criteria were identified.

- Informal telephone interviews were conducted with each of the nine vendors.

    - All of the interviews were conducted by INPUT senior staff.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

A. PRESENT PCB PACKAGES

- The following vendors offer, or plan to offer, PCB design software packages, including schematics, placement and routing, comparable to ASI/PRANCE.

    - Scientific Calculations, Inc. - SCI-CARDS.

    - Bell Northern Research, Ltd. - CPS/COPES.

    - Redac Interactive Graphics, Inc. - mini PCB designer.

    - Computervision - AUTOROUTE.

    - CALMA - CARDS.

    - Applicon - IMAGE.

    - MARK REVEL - AUTOMATE 80.

    - Vectron Graphics Systems, Inc.

    - Control Data Corporation - AIDS.

- Turnkey systems prices range from $200,000-600,000.

  - A turnkey system comparable to the proposed Lockheed/PRANCE PCB design system would be priced around $400,000.

- Lease prices ranged from $170,000-220,000.

  - The Bell Northern lease price of $220,000 would be somewhat comparable to the proposed Lockheed/PRANCE system.

  - Lease prices run about 60% of turnkey systems prices.

- Based on an analysis of the aforementioned vendors, INPUT has established ratings for both performance and recognition.

  - The rating of turnkey PCB CAD vendors is shown in Exhibit II-1.

    - A perfect rating would be 5-5 in the upper right-hand portion of the chart, which is presently unoccupied.

- Lockheed CADAM is well known, and the interactive PCB design system based on PRANCE could outperform all of the vendors.

- Lockheed has every opportunity to achieve a dominant position in PCB design for today's complex boards.

B.   ASI EVALUATION

- ASI/PRANCE is well known in the industry because of its performance in batch processing.

EXHIBIT II-1

RATING OF TURNKEY PCB CAD VENDORS

		1	2	3	4	5
EXCELLENT	5					!
	4	NORTHERN BELL				SCI-CARDS
PERFORMANCE RATING	3			MARK REVEL	REDAC COMPUTER-VISION	
	2	VECTRON				APPLICON CALMA
INADEQUATE	1					

RECOGNITION
RATING

UNKNOWN   WELL KNOWN

-     It has been evaluated by a number of companies, including Hewlett-Packard, which recently performed a benchmark comparison prior to leasing PRANCE.

-     There is no doubt that PRANCE is the most powerful router in the industry and is well suited to aerospace-type boards.

● ASI's reputation with its service bureau clients is excellent, and its service bureau business is viable.

C.   PRICING THE PCB PACKAGE

● Considering all of the following factors--

-     Present vendor lease pricing.

-     Lease pricing as a percentage of a comparable turnkey system.

-     Hewlett-Packard lease of PRANCE.

-     ASI development costs.

-     CADAM license pricing.

--INPUT recommends pricing the Lockheed/PRANCE package as follows:

-     Under CADAM - $100,000, or $2,500 per month.

-     Standalone - $250,000, or $6,300 per month.

D. MARKET PROJECTIONS

● INPUT forecasts the market for the Lockheed/PRANCE package to be a lease base of over $3 million per year, three years after the product offering.

   - This forecast is based on the above pricing, converting 40% of present CADAM installations and achieving an equal number of standalone installations in three years.

E. RECOMMENDATIONS

● Proceed with ASI negotiations to acquire rights to offer PRANCE.

● Acquire the full PRANCE capability.

   - Technical superiority is vital. Withholding certain PRANCE features that would diminish the placement and routing capability of the package would be detrimental.

● Establish a maximum total payment to ASI for PRANCE of $500,000, at which time Lockheed should own the rights.

● Offer the PCB package in two forms:

   - Under CADAM for $100,000, or $2,500 per month.

   - A standalone package for $250,000, or $6,300 per month.

- Design and document the PCB package completely consistent with CADAM.

  - Competition can be expected and marketing the Lockheed product with the full familiarity of CADAM will establish credibility.

- Conduct a survey to establish the market potential for the Lockheed/PRANCE product among:

  - CADAM licensees.

  - Independent computer centers - non-licensees.

  - Turnkey users.

III PRESENT OFFERINGS OF PCB
DESIGN PACKAGES

III   PRESENT OFFERINGS OF PCB DESIGN PACKAGES

A.   COMPARING PRICE AND PERFORMANCE

1.   LISTING OF VENDORS

- Nine vendors were identified that offer, or plan to offer, PCB design software packages or turnkey systems comparable to ASI/PRANCE.

    - The vendors are listed in Exhibit III-1.

- All of the vendors offer turnkey systems that include:

    - Schematics.

    - Placement.

    - Routing.

- Drafting System 1 (DSI), a "front-end" schematics package for doing electronic logic/schematics drawings, is offered by Design Aids, Inc. of Fullerton, California.

    - This schematics package interfaces with:

        . SCI-CARDS.

EXHIBIT III-1

PCB COMPUTER-AIDED DESIGN TURNKEY VENDORS

- SCI-CARDS

- BELL NORTHERN

- REDAC

- COMPUTERVISION

- CALMA

- APPLICON

- MARK REVEL

- VECTRON

- CDC

- REDAC.

- MARK REVEL.

- ASI/PRANCE.

- All of the vendors offer interactive systems, which is not the case with ASI/PRANCE.

- The vendors range in size from:

  - A very small, three-person company like Vectron, a spinoff from "Silicon Valley."

  - Small, specialized companies like SCI-CARDS, REDAC and MARK REVEL.

  - The larger, well-known, computer-aided design turnkey systems companies like Computervision, CALMA and Applicon.

  - Divisions of very large corporations like Bell Northern, Ltd. and Control Data Corporation.

2. SCIENTIFIC CALCULATIONS, INC. - SCI-CARDS

- SCI, a company of less than 50 people headquartered in Fishers, New York, offers an outstanding software package, SCI-CARDS.

  - SCI is a private company that started development of commercial software in 1970.

- A summary of the features of SCI-CARDS is shown in Exhibit III-2.

INPUT

EXHIBIT III-2

SCIENTIFIC CALCULATIONS, INC. - SCI-CARDS

- PRIME COMPUTER, INC.
- PRIME 750/2 OR VAX 11/780
  - IBM 370
  - NCSS
- TURNKEY
  - PRIME, 2 STATIONS - $300,000
- LICENSE - $170,000
  - $50,000 + $3,300/MO
- NUMBER OF STATIONS = 4 MAX.
- NUMBER OF COMPONENTS = 600
- NUMBER OF LAYERS = 20
- NEW SCHEMATICS PACKAGE, OR
  TIES TO DESIGN AIDS

INPL

- SCI has a marketing arrangement with Prime Computers, Inc., which is reflected in their joint marketing literature.

- Originally developed on the IBM 370 Series, it is now sold with either Prime or VAX computers.

  . SCI-CARDS is also available on National CSS, a rather unique arrangement.

- The turnkey price of $300,000 (or fully paid-up license to use of $170,000) and the features of the software make it fully competitive with all of the larger turnkey offerings now on the market.

  . Future enhancements are expected to keep it that way.

- Schematics were previously offered by interfacing with Design Aids, but SCI now has its own schematics package on the market as well.

- SCI-CARDS is widely regarded as the best interactive auto-router in the industry.

  - This distinction is well supported by benchmark data.

  - Design automation graphics and routing can be run simultaneously, an important advantage over competitive systems like CALMA's.

  - SCI-CARDS is regarded as major competition by the larger turnkey vendors, including Bell Northern and Computervision.

- Views of all of the vendors regarding their competition were consistent throughout this study.

  - Typical comments by other vendors about SCI-CARDS are shown in Exhibit III-3.

EXHIBIT III-3

- |4 -

SCI-CARDS - TYPICAL COMMENTS BY OTHER VENDORS

- "BEST AUTO ROUTER IN THE INDUSTRY, EVERYONE AGREES."

- "BENCHMARK WAS EXCELLENT."

- "UNIQUE, TIED INTO DESIGN AUTOMATION WHERE OTHERS CANNOT RUN SIMULTANEOUSLY."

- "NICEST PACKAGE IN THE INDUSTRY."

- "OUR MAJOR COMPETITION."

- "EXCELLENT ROUTER."

INP

- The evaluation of SCI-CARDS is best summed up by the comment by Computervision: "Best auto router in the industry, everyone agrees."

3. BELL NORTHERN RESEARCH, LTD. - CPS/COPES; BNR, INC.

- Bell Northern, headquartered in Ottawa, Canada, is a part of Bell Canada, a $6 billion company that used to be a part of AT&T.

  - COPES (Customer Optimized Product Engineering System) was put together for the internal use of Northern Telecom, a $102 million subsidiary corporation.

    - COPES was not, and is not today, regarded by Bell Northern as a commercial venture.

  - COPES is handled by yet another subsidiary corporation: BNR, Inc. (Bell Northern Research), a $140 million company.

  - BNR, Inc. has a group of 300 people and an IBM computer center in Mountain View, California, which is the focal point for COPES.

  - IBM is reported to have an interest in basing a PCB product offering on Bell Northern's COPES.

    - The fact that BNR is predominantly an "IBM shop" would account for IBM's knowledge of, and interest in, COPES.

  - BNR estimates the development costs for COPES at $8 million over six years.

- A summary of the features of Bell Northern's CPS/COPES is shown in Exhibit III-4.

EXHIBIT III-4

BELL NORTHERN RESEARCH, LTD. - CPS/COPES;

BNR, INC.

- CIRCUIT PACKAGE SYSTEM (CPS) - PART OF COPES

- TRANSFERRING BUSINESS TO CADEIS INTERNATIONAL, LTD.
  - CUSTOMERS IN FRANCE, GERMANY, SWEDEN,
    CANADA, U.S.

- DEC 2020

- TURNKEY
  - DEC, 3 STATIONS = $450,000

- LICENSE = $220,000

- NUMBER OF COMPONENTS = 400

- NUMBER OF LAYERS = 16

- RESOLUTION - 1 MIL.

- INCLUDES SCHEMATICS PACKAGE

INPU

- Marketing efforts have been confined to one person in Mountain View for U.S. sales, and one person in Ottawa for the rest of the world.

  - There have probably been less than ten turnkey systems sales.

  - However, numbered among their accounts are Messerschmidt, Siemens, Hessler and Philips.

- The marketing and distribution for COPES is being turned over on a royalty arrangement to CADEIS International, Ltd.

  - CADEIS is also located in Ottawa.

  - It was previously a REDAC distributor.

  - BNR reports that CADEIS ran a benchmark on all major competitors before selecting the Bell Northern CPS/COPES package.

- The system runs on a DEC 2020.

  - BNR has given consideration to converting the software, Fortran IV, to IBM. It places the conversion cost at $500,000.

- Features of CPS make it fully competitive with the other product offerings.

- The price, $450,000 for a turnkey system or $220,000 for a fully paid-up license to use, places it at the top range of competitive prices.

- Bell Northern is little known to the other vendors, who do not see CPS/COPES as competition.

  - Those vendors who did comment felt that SCI-CARDS was the better software package.

- The Bell Northern package is oriented toward the most complex PCB designs.

4. REDAC INTERACTIVE GRAPHICS, INC. - Mini-PCB Designer

- Redac is a private firm, started in 1975 and located in Littleton, Massachusetts.

    - Its annual revenues are $6 million, and it has a staff of 60.

- A summary of the features of the Redac system is shown in Exhibit III-5.

    - The mini-PCB designer is a one-station system, priced at the lowest end of the competitive range.

    - It runs on the DEC PDP 11/34 and also on the Hewlett-Packard 45.

    - License to the software is not available because it is customized to the hardware and is not readily transferable.

    - The schematics package is furnished by Design Aids.

- The Redac turnkey system is not a true computer-aided design system, but rather an aid to the designer.

    - It doesn't have the capacity of other routers.

    - However, within its limitations, it is regarded as a good, low-price product for a one-station system.

- Typical comments by other vendors concerning Redac are shown in Exhibit III-6.

INPU

EXHIBIT III-5

REDAC INTERACTIVE GRAPHICS, INC. - MINI-PCB DESIGNER

- DEC PDP 11/34

- TURNKEY
  - DEC, ONE STATION, STARTS AT $200,000

- LICENSE = NOT AVAILABLE

- NUMBER OF STATIONS = 1

- NUMBER OF LAYERS = 16

- NO SCHEMATICS PACKAGE,
  TIES TO DESIGN AIDS.

EXHIBIT III-6

REDAC - TYPICAL COMMENTS BY OTHER VENDORS

- "AID TO DESIGNER."

- "TAKES A MAN BEHIND THE TUBE."

- "BASIC SYSTEM, USER-ORIENTED."

- "DOESN'T ROUTE TO THE CAPACITY OF OTHER
  ROUTERS."

- "CAN'T OFFER A COMPLETE SYSTEM."

- "GOOD PRODUCT, THEY KNOW THEIR LIMITATIONS."

- "NOT THE BEST, BUT IS THE MOST POPULAR."

INPL

- The product is best summed up by Design Aid's comment: "Not the best, but the most popular."

5. COMPUTERVISION - AUTOROUTE

• By almost any measure, Computervision is by far the most successful of the turnkey systems vendors.

- A rapidly growing firm located in Bedford, Massachusetts, Computervision has 800 systems installed and annual sales of $100 million per year.

- It is generally recognized to have the best mechanical package in the industry, among the independent turnkey suppliers.

• A summary of the features of the Computervision PCB turnkey system is shown in Exhibit III-7.

- AUTOROUTE consists of the designer system (hardware) plus the CADDS 3 (software module).

- Computervision is unique in that its system runs its own processor in conjunction with the Data General NOVA.

- The system is clearly designed for the "commercial" marketplace, not for complex boards.

- Price for a typical system would be $350,000, with a range of $200,000 to $600,000, placing it as the model for the industry.

- Software licenses are not available, the software being integral with the CV hardware.

EXHIBIT III-7

COMPUTERVISION - AUTOROUTE

- AUTOROUTE - DESIGNER SYSTEM + CADDS 3

- COMPUTERVISION PROCESSOR/NOVA

- TURNKEY
  - RANGE = $200,000 TO $600,000

- LICENSE = NOT AVAILABLE
  - OPTIMIZED TO HARDWARE

- NUMBER OF STATIONS = 8 MAXIMUM

- MULTI-LAYER, MODERATE-COMPLEXITY BOARDS

- SCHEMATICS INCLUDED

INPU

- Typical comments by other vendors concerning Computervision are shown in Exhibit III-8.

    - The product is best described by Bell Northern's comment: "Good middle-of-the-road system with a middle-of-the-road price."

    - The Computervision PCB system has severe limitations and does not enjoy as superior a reputation as the Computervision mechanical package does.

6. CALMA - CARDS

- CALMA, a subsidiary of United Telecommunications, Inc., is located in Sunnyvale, California.

    - Sales and earnings are not reported separately from the parent corporation, but CALMA is one of the more successful turnkey CAD vendors, along with Computervision and Applicon.

    - CALMA's strength is in LSI/VLSI design, where its workstations are the standard of the industry.

    - Its PCB package is not highly regarded, and it has essentially no mechanical capability.

- A summary of the features of CALMA's CARDS system is shown in Exhibit III-9.

    - The system is based on a version of the MARK REVEL router, brought to CALMA by Russel Briggs of MARK REVEL, a well-known name in the industry.

        . CALMA reportedly has a disadvantage in enhancing the router software by not having access to the source code.

EXHIBIT III-8

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COMPUTERVISION - TYPICAL COMMENTS BY OTHER VENDORS

- "GOOD MIDDLE-OF-THE-ROAD SYSTEM WITH A
    MIDDLE-OF-THE-ROAD PRICE."

- "CAN ONLY ROUTE EASY BOARDS."

- "OFFERS A SMALL SOLUTION."

- "CV ROUTER HAS SEVERE LIMITATIONS."

EXHIBIT III-9

CALMA - CARDS

- DATA GENERAL ECLIPSE S-230
  - DUAL CPUS

- TURNKEY
  - STARTS AT $200,000
  - COMPETITIVE WITH APPLICON AND COMPUTERVISION

- LICENSE: NOT AVAILABLE

- NUMBER OF STATIONS = 6

- NUMBER OF COMPONENTS = 300

- NUMBER OF LAYERS = 20

- BASED ON MARK REVEL ROUTER

- THREE SEGMENTS
  - GRAPHICS
  - CONTINUITY CHECKS
  - ROUTER

INPUT

- The system runs on dual CPUs, Data General Eclipse.

- The features and prices are competitive in the industry.

    . There is one major disadvantage: the system cannot run design graphics and routing at the same time, making it cumbersome to use.

- Software is not available for license.

● Typical comments by other vendors concerning CALMA are shown in Exhibit III-10.

- These unenthusiastic comments reflect the fact that CALMA is not the force in the PCB design market that it is in LSI/VLSI design.

    . It is clear where CALMA has chosen to concentrate its efforts.

7. APPLICON - IMAGE

● Applicon is a highly successful, $50 million-per-year, public computer-aided design company located in Burlington, Massachusetts.

- It is a spinoff of Lincoln Laboratories of Bedford, Massachusetts.

- Applicon is highly successful in the mechanical design field and, to a lesser degree, in LSI/VLSI design.

● A summary of the key features of Applicon's IMAGE PCB system is shown in Exhibit III-11.

- The system is primarily based on DEC hardware.

EXHIBIT III-10

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CALMA - TYPICAL COMMENTS BY OTHER VENDORS

- "NOT ADEQUATE, CAN'T HANDLE LARGER JOBS."

- "DO NOT SEE THEM IN THE PCB INDUSTRY."

- "RUSSELL BRIGGS OF MARK REVEL SOLD ROUTER DESIGN TO CALMA."

- "SAME ALGORITHMS IN ROUTER AS MARK REVEL."

- "CANNOT RUN GRAPHICS AND ROUTER PACKAGES AT THE SAME TIME."

- "AWKWARD."

- "ACCEPTABLE ONLY FOR SMALL BOARDS."

- "WE EXCEED THEIR CAPACITY IN NUMBER OF COMPONENTS."

EXHIBIT III-11

APPLICON - IMAGE

- DEC IN TANDEM WITH APPLICON
  32-BIT MINIGRAPHICS 32

- TURNKEY: STARTS AT $200,000

- LICENSE:
  - $50,000

- SINGLE TERMINAL

- COLOR

- NUMBER OF LAYERS = 2

- NUMBER OF COMPONENTS = 500

- INCLUDES SCHEMATICS PACKAGE

- It is a one-terminal system.

- Turnkey prices are near those of Computervision and CALMA.

- Features fall considerably short of its competitors.

- Software is available for license at $50,000.

- Applicon clearly introduced an inferior PCB design package, and the industry is fully aware of the fact.

    - The router lacks capacity and is otherwise poorly designed.

- Typical comments by other vendors concerning Applicon are shown in Exhibit III-12.

    - As poorly as these comments reflect on the system, Applicon is not standing still.

    - The company is improving the system rapidly to make it competitive, if not superior, and given its general corporate strengths, most feel that Applicon will "get there."

    - The quote from Computervision is revealing: "They will be our most potent future competitor."

8. MARK REVEL - AUTOMATE 80

- MARK REVEL has two major locations, San Diego and Palo Alto, California. It is the small Palo Alto group that is concerned with the PCB design turnkey system, AUTOMATE 80.

    - The product development spans ten years, with the first product introduced in 1976.

EXHIBIT III-12

APPLICON - TYPICAL COMMENTS BY OTHER VENDORS

- "PCB DESIGN WAS A TERRIBLE SYSTEM,
  NOW MUCH IMPROVED AND COMING ALONG."

- "A REAL DOG FROM A ROUTING POINT OF VIEW,
  GOOD OTHERWISE."

- "ROUTER IS AN INFANT NOW, BUT THEY ARE
  WORKING ON IT VERY HARD, IT WILL BE GOOD."

- "MOST POTENT FUTURE COMPETITION."

- "THE VAX SYSTEM IS VERY ATTRACTIVE."

INPU

- The graphics interface has been greatly improved over the last 18 months.

  - Lockheed Missiles and Space Company uses two of the MARK REVEL turnkey PCB systems and speaks very highly of them.

    - It successfully uses the system for multilayer boards.

- MARK REVEL and Design Aids were involved in a joint study that benefited MARK REVEL with regard to a large-scale interactive digitizer, and MARK REVEL is tied to the Design Aids schematics package.

- Although MARK REVEL has a well-regarded placement and router system, it has not sold many systems and is not regarded by the major vendors as competition, at least not at this time.

- A summary of the major features of the MARK REVEL AUTOMATE 80 PCB design turnkey system is shown in Exhibit III-13.

  - The system is based on the Data General Eclipse processor.

  - It sells for a competitive turnkey price of $280,000, with fully competitive features.

  - The software is available for purchase or fully paid-up license to use for $110,000 for the placement and router plus $69,000 for the Design Aids schematic package.

- Typical comments by other vendors concerning MARK REVEL are shown in Exhibit III-14.

  - Computervision's comment sums it up: "Good features, but it is too early to tell how they will do."

EXHIBIT III-13

MARK REVEL - AUTOMATE 80

- DATA GENERAL ECLIPSE S-140

- TURNKEY = $280,000

- LICENSE

  - EX-SCHEMATICS PACKAGE = $110,000

  - SCHEMATICS PACKAGE =   69,000 (DESIGN
                                                  AIDS)

    TOTAL $179,000

- NUMBER OF LAYERS = 20

- TIES TO DESIGN AIDS
  SCHEMATICS PACKAGE

EXHIBIT III-14

MARK REVEL - TYPICAL COMMENTS BY OTHER VENDORS

- "GOOD FEATURES, BUT IT IS TOO EARLY TO TELL HOW THEY WILL DO."

- "LESS THAN 10 INSTALLATIONS."

- "VERY GOOD ROUTER."

- "EXCELLENT COLOR GRAPHICS SCOPE."

- "HAVE SEEN THEM IN COMPETITION ONLY ONCE."

9. VECTRON GRAPHICS SYSTEMS, INC.

- Vectron is a small PCB design service company located in Santa Clara, California.

  - It offers PCB design service over narrow-band telephone lines.

  - Vectron has a substantial Bay Area client in the Rohlm Corporation.

- A summary of the features of the Vectron PCB design system is shown in Exhibit III-15.

  - The system is offered on a turnkey basis for $200,000. It is based on the Perkin-Elmer Interdata processor.

- Vectron has developed a competitive router package that is unique in the sense that complete rights to the software for use or for resale outside of the Bay Area can be obtained for under $250,000.

10. CONTROL DATA CORPORATION - AIDS

- CDC developed a PCB/IC computer-aided design system for its own internal use, which they now plan to market to the industry.

  - A summary of AIDS features is shown in Exhibit III-16.

  - A powerful router is specifically aimed at complex aerospace boards that no system can adequately handle today.

- CDC plans to test market the system in the Bay Area in the first half of 1981.

  - Introduction of the product to the entire market is one to two years away, depending on the results of the test marketing.

EXHIBIT III-15

VECTRON GRAPHICS SYSTEMS, INC.

- PERKIN-ELMER INTERDATA 7/32

- TURNKEY : $200,000

- LICENSE:
    - COMPLETE RIGHTS TO THE SOFTWARE FOR USE
      OR RESALE <$250,000 OUTSIDE BAY AREA
    - SOFTWARE TIED TO HARDWARE

- MULTI-LAYER BOARDS

- NUMBER OF COMPONENTS - 300

INPUT

EXHIBIT III-16

CONTROL DATA CORPORATION – AIDS

- BASED ON INTERNAL CDC SYSTEM

- INCLUDES PCB AND IC LAYOUT CAPABILITIES

- ROUTER
    - GENERAL PURPOSE – HIGH DENSITY
    - SPECIAL PURPOSE FOR TOOLING OUTPUT

- "NOBODY CAN HANDLE AEROSPACE BOARDS NOW
    BEING SEEN IN CDC AEROSPACE DESIGNS"
    - CDC BROUGHT IN SCI-CARDS FOR EVALUATION

- MAY PURCHASE PCB OR IC PACKAGES SEPARATELY

- SYSTEMS OFFERING (CYBERNET):
    - TURNKEY
    - SERVICE
    - LICENSE

- MORE THAN 1 MILLION LINES OF SOURCE CODE
    - LICENSE $1 TO $2 PER LINE

- TEST MARKET IN BAY AREA IN 1981

- TOTAL MARKET 1 TO 2 YEARS AWAY

- AIDS will be a massive system, including VLSI design, with over a million lines of source code.

    - It can be obtained for PCB alone if desired.

    - The price for a corporate license will be between $1 and $2 per line of source code, or from $1-2 million.

11. PRICING SUMMARY

- A pricing summary of turnkey vendors' PCB computer-aided design systems is shown in Exhibit III-17.

    - Turnkey systems range from $200,000-600,000.

        . A system comparable to the proposed Lockheed PCB design system based on PRANCE is assumed to be priced around $400,000.

    - If the spurious lease price for Applicon is disregarded, leases range from $170,000-220,000.

        . The $220,000 lease price for Bell Northern would be somewhat comparable to the proposed Lockheed/PRANCE system.

    - It is useful to note that the lease prices range from 50-60% of the turnkey systems price.

        . SCI-CARDS' stated policy is to lease for 60% of its turnkey price.
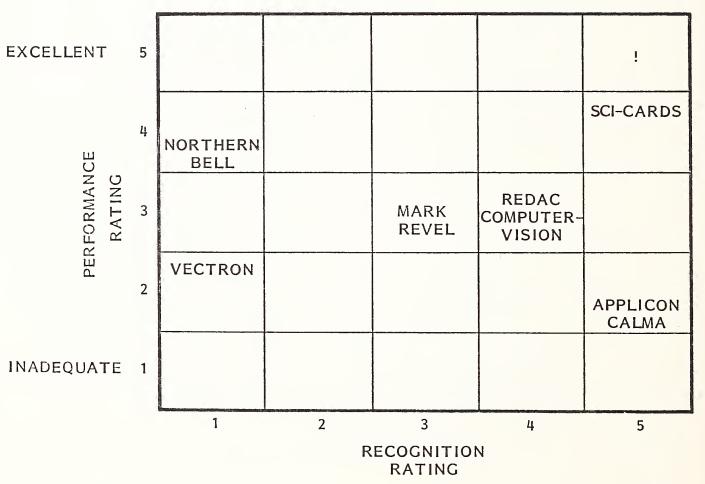
EXHIBIT III-17

PRICING SUMMARY OF TURNKEY VENDORS'
PCB COMPUTER-AIDED DESIGN SYSTEMS

VENDOR	LEASE	TURNKEY
• SCI-CARDS	$170,000	$300,000
• BELL NORTHERN	$220,000	$450,000
• REDAC	N/A	$200,000
• COMPUTERVISION	N/A	$200,000 UP
• CALMA	N/A	$200,000 UP
• APPLICON	$ 50,000	$200,000 UP
• MARK REVEL	$220,000 $179,000 WITH SCHEMATICS	$280,000
• VECTRON	N/A	$200,000

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B.   RATING THE VENDORS

● Based on the aforementioned comparisons, INPUT has rated the vendors for:

  - Performance, on a scale of 1 to 5, where 1 is inadequate and 5 is excellent.

  - Recognition, on a scale of 1 to 5, where 1 is unknown and 5 is well known.

● The rating of turnkey PCB CAD vendors is shown in Exhibit III-18.

  - A perfect rating would be 5-5 in the upper right-hand corner of the rating chart.

    . It is presently unoccupied.

  - SCI-CARDS comes the closest: it has good performance and is well known.

    . However, SCI-CARDS cannot handle the complex, aerospace-type boards of today.

  - Bell Northern has good performance, but under SCI-CARDS, and it is hardly known at all.

  - Redac, Computervision and MARK REVEL occupy the middle of the rating chart.

    . Computervision is very well known as a turnkey vendor, but not in PCB design.

EXHIBIT III-18

RATING OF TURNKEY PCB CAD VENDORS

INPUT

- Applicon and CALMA are well known, but have poor systems.

- Lockheed's interactive PCB design system based on PRANCE, the most powerful router in the industry, and running on CADAM software, could outperform all of the vendors.

- With IBM marketing, CADAM is well known and could be the best-known PCB design package in the industry.

- Lockheed has every opportunity to achieve a dominant position in PCB design for today's complex boards. INPUT believes that occupying the top, 5-5, position on the rating chart should clearly be the goal.

IV ASI EVALUATION

A. HEWLETT-PACKARD'S EVALUATION

- ASI has executed one license agreement for the rights to use the PRANCE software and that was with the Hewlett-Packard Corporation in December 1979.

- A summary of Hewlett-Packard's evaluation of ASI is shown in Exhibit IV-1.

  - HP brought PRANCE in for only one reason: to run the router package on the HP Amdahl processor to route complex, multilayer boards.

    - HP regards the PRANCE router as unique, and the most powerful in the industry.

  - The router benchmark data are based on a six-layer, 144 ICS board.

    - PRANCE was clearly superior to three other vendors, with SCI-CARDS next.

    - The number of unroutes for PRANCE was less than 1%, with no design rule violations.

EXHIBIT IV-1

- 44 -

HEWLETT-PACKARD'S EVALUATION OF ASI

- **PRANCE**

- **"BROUGHT IT IN FOR ITS POWERFUL ROUTER –**
  NOT ANOTHER ONE AROUND"

- **RUNS ON AMDAHL 470**

- **BENCHMARK DATA:**

COMPANY	NO. OF UNROUTES	DESIGN RULES VIOLATIONS
COMPUTERVISION	86	MANY
CALMA	40	NOT SO MANY
SCI-CARDS	32	NONE
PRANCE	1	NONE

- **LARGEST NUMBER OF UNROUTES HP HAS EXPERIENCED**
  ON A SIX-LAYER, 144 ICS BOARD:
    - **NINE**

EXHIBIT IV-1 (CONT.)

- 45 -

HEWLETT-PACKARD'S EVALUATION OF ASI

- LICENSE:
  - 1ST YEAR: $7,800/MO, (INCLUDES $1,500/MO. ENHANCEMENTS AND MAINTENANCE)

  - 2ND AND 3RD YEARS: $6,300/MO.

  - RENEGOTIABLE AFTER 3 YEARS

  - TOTAL = $245,000

- "GOOD ORGANIZATION, BUT
  - TRAINING FELL SHORT, LACK FORMAL MANUALS"

. Since PRANCE has been running, the largest number of unroutes HP experienced on the same complexity of board has been 6%.

- HP paid $245,000 for a three-year lease, or $6,300 per month for 36 months plus $1,500 per month for the first 12 months, for maintenance and enhancements.

- HP's overall impressions of ASI were quite positive. They found them capable and cooperative.

. However, ASI was deficient with respect to training and documentation, something that Lockheed is very likely to encounter as well.

B.   SUMMARY EVALUATION

● INPUT's conclusions with respect to ASI are as follows:

- ASI is a capable small company that is reasonable to do business with.

- It has a unique and valuable product in PRANCE.

- Its reputation as a service bureau is good.

- The service bureau is a viable business running at about $2 million per year.

- The system is not interactive, thus it is not competitive in its present form.

- ASI has an inflated view of the value of a PRANCE license; $395,000 is noncompetitive.

INPU

- PRANCE is best suited for complex boards.

- Typical comments by other vendors concerning ASI are shown in Exhibit IV-2.

    - They are best summed up by Bell Northern's comment: "Batch system is one hell of a package."

EXHIBIT IV-2

ASI - TYPICAL COMMENTS BY OTHER VENDORS

- "BATCH SYSTEM IS ONE HELL OF A PACKAGE."

- "HAVE RECEIVED EXCELLENT SERVICE FROM ASI."

- "SERVICE BUSINESS IS RUNNING $2 MILLION/YEAR."

- "SYSTEM IS NOT INTERACTIVE, THUS NOT COMPETITIVE."

- "NOT COMPETITIVE BECAUSE OF EXPENSE, $395,000 FOR SOFTWARE LICENSE."

- "BEST SUITED TO MILITARY BOARDS."

- "MOST POWERFUL ROUTER IN THE INDUSTRY."

V PRICING THE PCB PACKAGE

V   PRICING THE PCB PACKAGE

A.   RELEVANT FACTORS

●   There are five different factors that are relevant to pricing the Lockheed PCB design package, as shown in Exhibit V-I.

- First, current market prices for fully paid-up leases for rights to use the software for comparable products are now on the market.

    • The Bell Northern lease price of $220,000 is the most pertinent.

- Second, establishing a lease price of around 60% of the price for a turnkey system is pretty much a norm for the industry.

    • A turnkey PCB design system of the complexity of the proposed Lockheed/PRANCE system would be around $400,000; this would result in a lease price of $240,000.

- Third, the ASI lease pricing to Hewlett-Packard is indicative of the market.

    • INPUT believes that the suggested $395,000 lease price is much higher than the market will bear, but that the $245,000 lease that Hewlett-Packard was willing to assume is about right.

EXHIBIT V-1

FACTORS RELEVANT TO LOCKHEED
PCB DESIGN PACKAGE PRICING

- TURNKEY VENDORS' LICENSING $170-220,000

- SIXTY PERCENT OF $400K T/K SYSTEM $240,000

- ASI PRICING
  - PROPOSED FULL SYSTEM $395,000 $7,700/MO
  - PROPOSED PARTIAL SYSTEM $ 85,000 $2,000/MO
  - HP LEASE $245,000 $6,300/MO

- ASI DEVELOPMENT COSTS $500-750,000

- CADAM LICENSE $170,000 $4,000-
                                                5,000/MO.

- Fourth, the ASI development costs for PRANCE set an upper limit on lease pricing.

    . ASI estimates that 18 person years have gone into PRANCE development. At $40,000 per person year, this would be a development cost of $720,000.

- Fifth, when the PCB design package runs under CADAM, the CADAM license price must be considered.

    . The current CADAM license fee is $170,000.

B. PRICING

- Considering all of the aforementioned factors, INPUT believes that a fair price for the Lockheed/PRANCE PCB design package on the open market is $250,000, or $6,300 per month for a 40-month, fully paid-up license to use the software.

- The market is believed to be relatively insensitive to price, given excellent performance for aerospace-type boards, so the above price could be "adjusted" somewhat.

    - However, CADAM licensees would be very sensitive to price compared to present CADAM license fees.

- INPUT believes that the current $170,000 license fee for PRANCE is much too low, and that it should be adjusted upward by at least 50%.

    - Recognizing that there may well be constraints on pricing, this may have to be done in annual increments.

- INPUT recommends that Lockheed offer the PCB package as a module of CADAM at $100,000, and as a standalone package priced at $250,000, as shown in Exhibit V-2.

- The product offered to CADAM users will be viewed as a major enhancement to CADAM, and should be priced consistently with the current CADAM license fee.

    - The costs of selling the product to existing CADAM licensees and the costs of servicing the account are also much lower than a non-CADAM standalone sale.

- The market for a standalone product includes:

    - Independent computer centers, non-licensees, IBM or IBM-compatible.

    - Turnkey users wishing to avoid a proliferation of turnkey systems in favor of networking on a central computer.

- The standalone market could be a very profitable "sleeper" market.

    - It would require marketing effort, "word-of-mouth" or reference selling, but not a direct sales effort.

    - Demand could be very high for a new product that fulfills present needs for the design of complex printed circuit boards and runs on IBM or IBM-compatible computers, like the HP lease of PRANCE.

EXHIBIT V-2

PRODUCT OFFERINGS OF
LOCKHEED/PRANCE PCB DESIGN PACKAGE

- FULLY PAID-UP LICENSE TO USE - PURCHASE
  OR 40-MONTH LEASE.

- - UNDER CADAM
  . $100,000 OR $2,500/MO.
      + MAINTENANCE AND ENHANCEMENTS

- - STANDALONE
  . $250,000 OR $6,300/MO.
      + MAINTENANCE AND ENHANCEMENTS

VI MARKET PROJECTIONS

VI   MARKET PROJECTIONS

- For a given set of assumptions, INPUT forecasts the market for the Lockheed/ PRANCE PCB design package to be over $3 million per year in three years after the product offering, as shown in Exhibit VI-1.

    - The model assumes a lease base of 40 months.   Purchases would be treated as equivalent leases.

    - The conversion of 40% of present CADAM installations was assumed to be 10% in the first year, 20% in the second and 10% in the third.

        . No allowance was made for sales to new CADAM users.

    - An equal mix of CADAM and standalone sales was assumed.

EXHIBIT VI-1

MARKET FORECAST

- **$3.3 MILLION/YEAR LEASE (OR PURCHASE EQUIVALENT) BASE IN THREE YEARS**

- **ASSUMPTIONS:**
    - UNDER CADAM $2,000 PER MONTH
      ($100,000 PURCHASE)
    - STANDALONE $6,300 PER MONTH
      ($250,000 PURCHASE)
    - CONVERT 40% OF PRESENT CADAM
      INSTALLATIONS IN THREE YEARS
    - ACHIEVE AN EQUIVALENT NUMBER OF
      STANDALONE INSTALLATIONS IN THREE
      YEARS

INPUT

VII LOCKHEED / ASI RELATIONSHIPS

VII   LOCKHEED/ASI RELATIONSHIPS

A.   TECHNICAL

1.   PRODUCT

- It is essential that the acquired product be technically compatible with CADAM and that a fully interactive system capable of running design graphics and routing simultaneously be developed.

- Technical superiority is the key to success, so the product must include all the features available.

    - ASI's withholding certain PRANCE features that would diminish the placement and routing capability of the package would be intolerable.

2.   PRODUCT SUPPORT

- Expertise in the PRANCE software rests with a few ASI people.

    - ASI is vulnerable to the loss of key individuals.

    - These individuals could be diverted to other areas.

- Lockheed should be prepared to assume the full burden of maintenance and enhancement of the software.

- ASI does not have the training or documentation capability. Lockheed should assume responsibility for these areas as well.

B. FINANCIAL

- As previously discussed, the product price must be compatible with CADAM when offered as a module of CADAM rather than a standalone system.

- Total payments to ASI for PRANCE license fees should not exceed development costs.

    - Lockheed is only acquiring rights to part of the PRANCE software (placement and routing) so INPUT recommends that payments to ASI for PRANCE be limited to a maximum of $500,000.

    - The agreement should provide for Lockheed to own complete rights for the sale of PRANCE software, without payment of royalties, when this level of payment to ASI is reached.